6.0 Repair Assessment Process

This section describes the elements of the repair assessment process:

- Baseline Zonal Inspection Program
- Structural Repair Manual Updates
- OEM Model Specific Repair Assessment Guidelines
- Program Implementation

6.1 Overview

The OEMs will provide SRM updates and model specific repair assessment guideline documents. With these documents, operators will be able to assess existing repairs to determine which permanent repairs require supplemental inspections beyond specific implementation times. Temporary repairs can also be assessed to determine the need for supplemental inspections before they reach their replacement implementation time. The documents can also be used to assess the maintenance requirements for repairs installed in the future. The OEMs have developed a Baseline Zonal Inspection (BZI) reflecting typical inspection intervals to facilitate the classification of repairs and need for supplemental inspections.

6.2 Program Objective

The objective of the repair assessment process is to assure continued structural repair airworthiness equivalent to unrepaired similar principal structural elements. The priority is to assess fuselage pressure boundary repairs for eleven pre-Amendment 45 airplanes (A-300, F-28, BAC 1-11, L-1011, DC-8, DC-9/MD-80, DC-10, 707/720, 727, 737, 747) with emphasis on the out-of-production models. Model specific repair assessment guidelines published by the OEMs could also be used to determine inspection requirements to meet the intent of AC 25.1529.1 for new repairs. The guidelines may be expanded to cover other structure beyond the fuselage pressure boundary, provided that it is fully justified through enhancement of continued structural airworthiness. The proposed repair assessment process could also be applied to post-Amendment 45 airplanes in satisfying AC 25.1529.1 guidance.

6.3 Baseline Zonal Inspections Program

The Baseline Zonal Inspection (BZI) reflects typical maintenance inspection intervals assumed to be performed by most operators. The BZI serves as an evaluation tool for some OEMs to establish criteria for supplemental inspections, repair size limits, etc. Some OEMs have developed the BZI in

conjunction with Structures Task Group (STG) activities. The BZI provides opportunities to simplify the repair screening process (Section 6.5) with regards to structural locations based on stress environment and zonal critical details. The BZI will be listed in the OEM model specific guidance documents (Section 6.5). The operators have expressed their concurrence that the BZI is useful to simplify repair assessments. Appendix F of Attachment 2 shows a typical BZI program that would be used to evaluate the need for supplemental inspections of a repair.

6.4 Structural Repair Manual Content

Model specific Structural Repair Manuals (SRMs) will be updated by the OEMs to reflect damage tolerance repair considerations.

The general section of each SRM, Chapter 51, will contain brief descriptions of damage tolerance considerations and categories of repairs (Section 6.7). Chapter 53 for pressurized fuselage skin will be updated to identify repair categories and related information.

In updating each SRM, existing location specific repairs will be labeled with appropriate repair category identification (see Section 6.5 for repair categorization) and specific inspection requirements will also be provided as applicable.

Generic SRM repairs will also contain repair category considerations regarding size, zone and proximity to other repairs. Detailed information for determination of inspection requirements will be provided in separate guidance material for each model (Section 6.5). Repairs that are superseded in the future will be labeled inactive and remain in the SRM. Maintenance programs (e.g. inspection and , if necessary, replacement requirements) for superseded repairs will be added to the SRM. Updates of the SRM will be FAA (or equivalent) approved in line with current practice for revision approvals. An example of a typical SRM update is shown in Appendix G of Attachment 2.

The goal is to complete these updates within one year of AAWG, ARAC and STG adoption of the recommendations contained herein but not later than one year prior to the effective date of the rule. Consistent with the results of the industry surveys used to establish this program (Section 5.0), emphasis will be on external fuselage pressure boundary repairs.

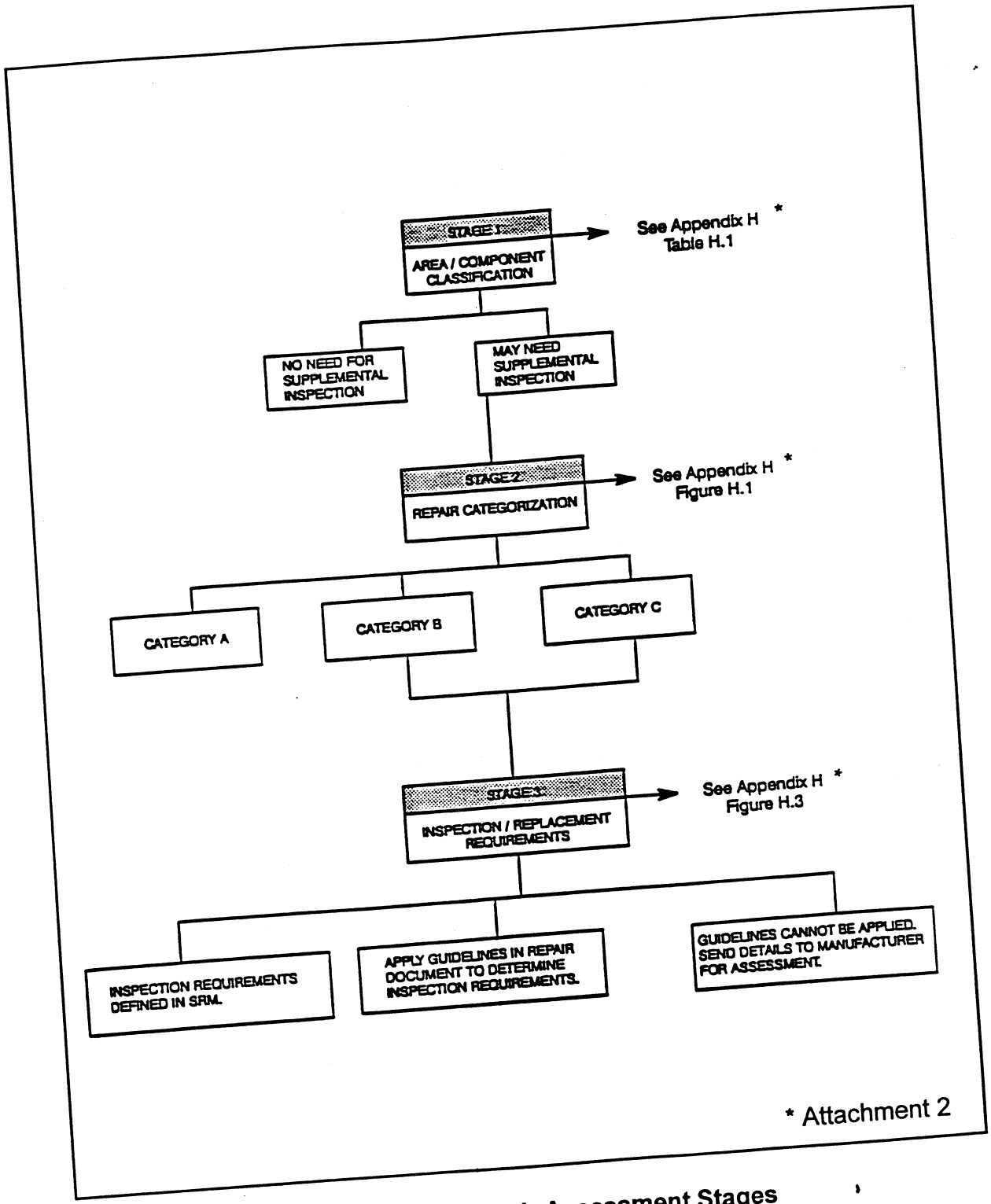

Figure 6.1 Repair Assessment Stages

6.5 Repair Assessment Guidance Material

Model specific documents will be prepared by the OEMs for the eleven aging airplane models. Uniformity/similarity of these repair assessment procedures are important to simplify operator workload. The OEMs have spent considerable time over the last five years to achieve commonality of the repair assessment process.

The model specific documents will describe rationale for repair Categories A, B and C:

- Category A

  A permanent repair for which the Baseline Zonal Inspection is adequate to ensure continued airworthiness (inspectability) equal to unrepaired surrounding structure.

  Category A fuselage skin repairs are encouraged unless operator convenience and scheduling dictates Category 'B' or 'C' selection.

- Category B

  A permanent repair which requires supplemental inspections to ensure continued airworthiness.

  The design goal for new Category B repairs should be equivalent to the basic structure design service goal in flight cycles.

- Category C

  A temporary repair which will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

A number of different means may be used to incorporate the assessment guidelines into an operators maintenance program. One method is to incorporate the entire guidelines into the normal maintenance program similar to any other maintenance program. A program of this nature is suitable for any size of fleet but has distinct advantages for the larger operator who does not want to track individual repairs.

Another approach, more suitable for the small operator, is detailed below. This approach is known as the three stage approach (Figure 6.2) and is further detailed by an example contained in Appendix H of Attachment 2:

- STAGE 1 - DATA COLLECTION

  - This stage specifies what structure should be assessed for repairs. If a repair is on a structure in an area of concern, the analysis continues, otherwise the repair does not require classification per this program.
  - Guidance material documents for each model will provide a list of structure for which repair assessments are required. Some OEMs have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks(e.g. BZI check), those details were excluded from this list.
  - Repair details are collected for further analysis in Stage 2. Repairs which do not meet the static strength requirements or are in a bad condition are immediately identified and corrective action must be taken before further flight.

- STAGE 2 - REPAIR CATEGORIZATION

  - The repair categorization is determined by using the data gathered in Stage 1 to answer simple questions regarding structural characteristics.
  - Well designed repairs in good condition meeting size and proximity requirements are Category A. Simple condition and design criteria questions are provided in Stage 2 to define the boundaries of Category A, B and C repairs. The process continues for Category B and C repairs.

- STAGE 3 - DETERMINATION OF SUPPLEMENTAL MAINTENANCE REQUIREMENTS

  - The supplemental inspection and/or replacement requirements for Category B and C repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the OEM, STC holder or other values obtained using an FAA approved method.
  - The inspection intervals are based on residual strength, crack growth and inspectability evaluations. The inspection methods and intervals should be compatible with typical operator maintenance practice. Internal inspections are acceptable at 'D'-check or equivalent cycle limit intervals while simpler external inspections can be accommodated at multiple 'C'-check or equivalent cycle limit intervals.

A list of applicable Service Bulletins (SBs) and Airworthiness Directives (ADs) will be included and will be assessed by the OEM per Section 6.6. The required post modification/repair inspection programs will also be included.

The threshold for the first supplemental inspection will be defined in flight cycles and will be determined by the procedures found in the model specific documents. If the time of installation of the repair is unknown and the airplane has exceeded the assessment implementation time or has exceeded the time for first inspection, the first inspection should occur by the next 'C' - check interval or cycle limit equivalent after the start of the assessment process.

Incorporating the maintenance requirements for 'B' and 'C' repairs into the operators individual airplane maintenance program completes the repair assessment process.

The AAWG recommends that the assessments should be performed by well trained personnel, familiar with the damage tolerance assessment of repairs outlined in the model specific guidance material. The OEMs have agreed to provide training to both the operators and regulators to familiarize them on assessment criteria and implementation.

6.6 Fuselage External Pressure Boundary Service Bulletin Repairs

The OEMs should review repairs identified in Service Bulletins (SBs) to determine requirements for supplemental inspections if not already addressed. Structural modifications (either terminating repairs or preventative modifications) to terminate repeated inspections required by Airworthiness Directives (AD) do not always contain instructions for future supplemental inspection requirements. The AAWG recommends that these structural modifications be reviewed by the OEMs to evaluate the need for post modification inspections. This activity should be reviewed by the model specific OEM Structures Task Group. A list of Service Bulletins that are the subject of Airworthiness Directives will be contained in the model specific program document with required post modification inspection/repair programs as applicable.

A list of other structural SBs will be provided in the model specific guidance material with associated inspection thresholds and repeat intervals (separate repair assessment documents per Section 6.7). OEMs should complete their review of SB related skin repairs in conjunction with the initial SRM updates (Section 6.4).

6.7 Repair Assessment Implementation Time

Implementation time for assessments of existing repairs are based on the findings of the repair surveys and fatigue damage considerations. The repair survey findings indicated that all repairs reviewed appeared in good structural condition. It was therefore concluded that the assessment needed to be implemented sometime before a specific model reached it's Design Service Goal (DSG). Based on this logic, the OEMs and operators established an upper bound for an assessment to be completed and then reduced it to establish an implementation time. The upper bound for the incorporation of the repairs assessment program into an airplane's maintenance program was established as 75% of the DSG in the terms of flight cycles. The implementations times specified for each model are shown in Figure 6.2.

Existing fuselage repairs should be assessed using one of the procedures described in Section 6.5. The FAA Approved OEM model specific guidelines document specifies the specific cycle limits of when the assessment process must start. There are three implementation levels depending on the cycle age of the aircraft on the effective date of the proposed rule.

- Airplane cycle age equal to or less than Implementation time on the rule effective date. The operator would be required to incorporate the guidelines in his maintenance or inspection program by the flight cycle implementation time, or one year after the effective date of the rule, which ever occurs later. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit specified in the RAG (generally equivalent to a 'D' check) after incorporation of the guidelines.

- Airplane cycle age greater than Implementation time but less than Design Service Goal on the rule effective date. The operator would be required to incorporate the guidelines in his maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of Stage 1) on or before the cycle limit in the RAG (generally equivalent to a 'D' check), not to exceed the cycle limit computed by adding the DSG to the cycle limit equivalent of a 'C'-check (also specified in the RAG) after incorporation of the guidelines.

- Airplane cycle age greater than Design Service Goal on rule effective date. The operator should incorporate the guidelines in his maintenance or inspection program within one year of the rule effective date. The assessment process would begin (e.g. accomplishment of

Stage 1) on or before the next 'C'-check or cycle limit specified in the RAG (equivalent to a 'C' check) after incorporation of the guidelines.

Model	Implementation time (Flights)
A-300	36,000 - B2
A-300	30,000 - B4-100 above window belt
A-300	36,000 - B4-100 below window belt
A-300	25,500 - B4-200 above window belt
A-300	34,000 - B4-200 below window belt
BAC 1-11	60,000
B 707	15,000
B 720	23,000
B 727	45,000
B 737	60,000
B 747	15,000
DC-8	30,000
DC-9/MD-80	60,000
DC-10	30,000
L-1011	27,000
F-28	60,000 - mark 1000, 1000C, 2000, 3000, 3000C and 4000

- Note: the A-300-B4-600, F-28 mark 70, and the F-28 mark 100 are certified to post amendment 54 and are not considered part of this rule process.

Figure 6.2 OEM Recommended Repair Assessment Implementation Times

6.8 Incorporation of Assessment Guidelines into a Maintenance Program

The implementation of the program is at the operator/individual airplane level. In order to comply with the requirements of the rule, an operator must update and have approved his means of approach on an individual airplane maintenance level prior to an airplane reaching it's model specific repair implementation time (Paragraph 6.7) unless the airplane has exceeded or is within one year of exceeding the stated implementation time in which case the operator has one year from the effective date of the rule to do so.

The FAA Approved model specific OEM guidance documents specify when the repair assessments need to be accomplished and are in terms of flight cycles or a cycle limit.

The means by which the FAA Approved repair assessment guidelines is incorporated into a certificate holders FAA Approved Maintenance Program as required by the rule is the subject of negotiation between the certificate holder and his PMI with the exception of the following issues which must be submitted to the cognizant FAA ACO for approval:

- Implementation times,
- Threshold and repeat inspection methodology different from the FAA approved documents or any other FAA approved method,
- Changes to the baseline zonal inspection program,
- New methods of inspection.

6.9 Publication of OEM Documentation

For airplane models in which the high time airplane has not reached the respective model specific repair assessment implementation times, the SRM updates and model specific guidance documents should be available a minimum of one year prior to the high time airplane reaching the implementation time (Figure 6.2). In the event that the high time airplane is within one year of the implementation time or has already exceeded the implementation time, the documentation will be available one year prior to the effective date of the rule.

Model specific documents will be reviewed for consistency by the cognizant STG prior to OEM submittal to the FAA for approval. STG recommendations for changes to the document will be considered by the OEM.

6.10 Training

The complexity of the repair assessment requires adequate training for proper implementation. Therefore the AAWG recommends that each OEM provide detailed in-depth training for all operators of the airplanes considered by this rule. In addition, the AAWG further recommends that the OEM provides similar in-depth training to the Regulator's Principal Inspectors who are charged with the responsibility of operator oversight of the program.

6.11 Program Implementation Examples

The following describe three variants of acceptable means to comply with FAR 91.XXX, 121.XXX, 125.XXX AND 129.XXX. These examples are not exhaustive and are intended to show a variety of different acceptable ap-

proaches. Any approach adoped as a means of compliance to the proposed rules would need to be approved by the regulatory authority.

Example 1. At a prescribed "D" check or equivalent cycle limit, the effected airplane will require the following activities:

(a) Using the guidelines agreed upon by the model specific Structures Task Groups (STG) and the OEM, the operator will evaluate each repair on the fuselage pressure boundary [fuselage fuselage skins and bulkhead webs] to determine it's repair categorization and applicable continued airworthiness inspection or replacement program.
(b) Category 'C' repairs may be evaluated to determine if it should be improved immediately or reinspected for upgrade at a later time.
(c) If it can be shown that category 'B' or 'C' repair inspection requirements are already fulfilled by a maintenance planning item, there is no need to add a specific maintenance task item in the approved maintenance program applicable to the airplane. If not, the approved maintenance program for the airplane will need to be updated accordingly to include the specific additional maintenance requirements applicable to the repair.

Example 2. Operators with large fleets who do not wish to track each individual repair but instead wish to demonstrate compliance during routine heavy maintenance visits may utilize the following procedure as a means of compliance to FAR 91.XXX, 121.XXX, 125.XXX AND 129.XXX.

(a) An "alarm clock" would be installed in the individual airplane maintenance program to monitor individual airplane landing cycles. This alarm clock would be activated upon an airplane reaching it's implementation age and issue a routine job instruction package for the maintenance visit. This routine job instruction package would consist of:

(1) A diagram segmenting the airplane pressure shell into small zones.
(2) A requirement to inspect each zone to identify repairs for possible inspections.
(3) A requirement to evaluate each repair per OEM repair program guidelines and the SRM to ensure repairs satisfy 'B' or 'A' repair category. An operator could maintain a repair log of each airplane to aid in the identification of existing repairs at subsequent airplane visits.
(4) An individual repair that does not satisfy the requirements for continued airworthiness until the next heavy maintenance visit, will require replacement with one that does .

(5) An individual repair that does not meet the criteria of 'B' or 'A' repairs, inspection personnel would need to perform a high frequency eddy current inspection of the rows of fasteners specified by the OEM for cracks. If cracks are found, repair would be replaced with a new "B" or "A" category repair.

(6) All records of findings and repairs would be required to be documented per normal maintenance practices. No special reporting requirements are required.

(7) New repairs would be installed per revised OEM SRM's or OEM model specific guidance material.

(b) The procedure above will be repeated at each heavy maintenance visit.

Example 3. The following example illustrates an acceptable program where repair categorization occurs at a implementation time and the actual repair inspection occurs at a later time.

(a) Implementation. Enter into the model specific Approved Maintenance Schedule a rule requiring the repair survey at what ever implementation time is applicable for that model airplane.

(b) Categorization. Inspection for repairs would be by routine card packaged onto the appropriate airplane check by maintenance planning. A defect card would be raised against each repair which in turn would require the assessment to be carried out by airline engineering personnel trained in the assessment procedure. The airline personnel would be required to fill out the assessment form, complete the assessment and repair categorization accordingly. A copy of the completed form would be attached to the defect card as a means of clearing assessment requirements. The two forms would then be placed in the permanent airplane maintenance log. After categorization the engineering personnel would be responsible for establishing method and frequency of inspections and entering them into the approved maintenance schedule (AMS).

(c) Control of Inspections and replacement times. Control for 'B' or 'C' category repairs would be controlled via the AMS. In certain circumstances, details of category 'C' repairs that have a restricted life limit may be entered into the Deferred Maintenance section of the Airplane Log book until the repair is replaced at or before reaching the life limit.